(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 April 2001 (26.04.2001)

PCT

(10) International Publication Number
WO 01/28765 A1

(51) International Patent Classification[7]: B32B 5/02, 17/02, 17/04, 17/10, 27/04, 27/08, 27/12, 27/32, 27/36, 31/20, 31/26, C08J 5/04, 5/06, 5/18

(21) International Application Number: PCT/US00/27989

(22) International Filing Date: 10 October 2000 (10.10.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/418,929 15 October 1999 (15.10.1999) US

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(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 01/28765 A1

(54) Title: ROOF SHEET FOR A TRAILER

(57) Abstract: A novel roof sheet for a trailer is formed from a thin sheet of laminate. The laminate is formed by providing a woven mat formed from rovings of commingled fiberglass and thermoplastic resin, preferably polypropylene; commingling the fiberglass and thermoplastic resin by heat and compression to form a thin sheet ot laminate by heating and compressing said woven mat; and cutting the thin sheet of laminate into a size which is suitable for attachment to a frame of a trailer. A film, preferably polyester, capable of blocking ultraviolet light can be bonded to the thin sheet of laminate.

ROOF SHEET FOR A TRAILER

BACKGROUND OF THE INVENTION

This invention is generally directed to a novel roof sheet for a trailer. More particularly, the invention contemplates a novel roof sheet for a trailer which is formed from a sheet of fiberglass reinforced plastic laminate. The sheet of laminate is formed by heating and compressing a woven mat of commingled fiberglass and thermoplastic resin.

The disadvantages of solvent-based and melt-based processes led to the development of a commingled technique, such as the commingled technique developed by Certainty Glass Corporation. This technique is based on the concept of intimately placing the polymer within the fibers without using a melt-based impregnation. In co-mingled thermoplastics, wet-out of the fibers and consolidation is made possible at lower pressures without long exposures to melt temperatures. As a result of new techniques for producing commingled fiberglass and thermoplastic resin, the cost of using this material has steadily been decreasing.

The present invention uses a consolidated sheet of laminate for a roof sheet of a trailer. The sheet of laminate is formed from a woven mat of plurality of rovings formed from commingled fiberglass and thermoplastic resin that is heated and compressed. The usage of this type of material is advantageous in that it is lightweight and easy to produce.

OBJECTS AND SUMMARY OF THE INVENTION

A general object of the present invention is to provide a novel roof sheet for a trailer.

An object of the present invention is to provide a novel roof sheet for a trailer which is formed from a sheet of fiberglass reinforced plastic laminate.

Another object of the present invention is to provide a sheet of laminate that is used to form novel roof sheet of a trailer, wherein the sheet of laminate is formed from formed by heating and compressing a woven mat of commingled fiberglass and thermoplastic resin.

A further object of the present invention to provide a roof sheet that is lightweight and easy to manufacture.

Briefly, and in accordance with the foregoing, the present invention discloses a novel roof sheet for a trailer. The roof sheet is a thin sheet of laminate that is formed by providing a woven mat formed from rovings of commingled fiberglass and thermoplastic resin, preferably polypropylene; commingling the fiberglass and thermoplastic resin by heat and compression to form a thin sheet of laminate by heating and compressing said woven mat; and cutting the thin sheet of laminate into a size which is suitable for attachment to a frame of a trailer. A film, preferably polyester, capable of blocking ultraviolet light can bonded to the thin sheet of laminate.

BRIEF DESCRIPTION OF THE DRAWINGS

The organization and manner of the structure and operation of the invention, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawings, wherein like reference numerals identify like elements in which:

FIGURE 1 is a top elevational view of a woven mat of a plurality of rovings, each roving being formed of a plurality of commingled fibers and thermoplastic resin;

FIGURE 2 is a cross-sectional view of the mat through line 2-2 of FIGURE 1;

FIGURE 3 is a side elevational view, shown partially in cross-section, of an assembly for effecting a combined formation of the woven mat and a film into a sheet of laminate in one integrated step in and a continuous process for continuously forming a roof sheet in accordance with the present invention;

FIGURES 4 and 5 are cross-sectional views of a novel structure for containing the thermoplastic resin during the consolidation of the commingled woven mat in the assembly of FIGURE 3; and

FIGURE 6 is a perspective view of a trailer which has a roof sheet formed in accordance with the present invention.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

While the invention may be susceptible to embodiment in different forms, there is shown in the drawings, and herein will be described in detail, a specific embodiment with the understanding that the present disclosure is to be considered an exemplification of the principles of the invention, and is not intended to limit the invention to that as illustrated and described herein.

The present invention provides a novel roof sheet 20 for a trailer 22, FIGURE 6, which is formed from a sheet of fiberglass reinforced plastic laminate 24. The sheet of laminate 24 is formed by heating and compressing a woven mat 26 of commingled glass fibers 28 and thermoplastic resin 30, preferably polypropylene, to form a laminate 24 of continuous-glass-fiber-reinforced-polypropylene.

As shown in FIGURE 1, the woven mat 26 is made of a plurality of rovings 32 woven together. As shown in FIGURE 2, each roving 32 is formed from a plurality of lengths of unconsolidated glass fibers 28 and thermoplastic resin 30 bundled together. The rovings 32 are formed by using conventional commingling techniques to intimately place the thermoplastic resin 30 within the glass fibers 28 without using a melt-based impregnation. The commingling is performed in the glass manufacturing operation at very high speeds of over fifty feet per second, wherein the thermoplastic resin 30 is drawn along with the glass fibers 28. Therefore, for an end user, the material form does not involve any intermediate suppliers and the consolidation does not involve high pressures and temperatures characteristic of melt-based processes. Continuous-glass-fiber-reinforced-polypropylene can be consolidated at low pressures (approximately 100-150 psi), and high speeds (approximately 25 in/sec), reducing costs and satisfying high volume needs.

FIGURE 3 illustrates an assembly for combined consolidation of the woven mat 26 and bonding a film 34 thereon to form the sheet of laminate 24 in one

integrated step in and a continuous process by using a continuous press 36. A first upper section 38 of the press 36 has a plurality of platens 40 mounted on an endless chain 42 and is herein called the "consolidation section." The endless chain 42 is mounted around pair of spaced apart, toothed wheels 44, 46. Between the toothed wheels 44, 46, a support beam 48 is provided within the endless chain 42. A heater 50 is provided above the platens 40 in the consolidation section 38 to heat an outer surface of the platens 40 as they pass thereby. A second upper section 52 of the press 36 has a plurality of platens 54 mounted on an endless chain 56 and is herein called the "cooling section." The endless chain 56 is mounted around a pair of spaced apart, toothed wheels 58, 60. A support beam 62 is provided within the endless chain 56 and is mounted between the toothed wheels 58, 60. The consolidation section and the cooling sections 38, 52 of the press 36 are in-line with each other. The cooling section 52 may be shorter in length than the consolidation section 38. In addition, an endless release belt 64, which may be made of out of a suitable no-stick material, such as TEFLON® impregnated cloth or stainless steel, encircles the consolidation and cooling sections 38, 52 of the press 36. The release belt 64 is supported on a plurality of rollers 66. The heater 50 is provided between the consolidation section 38 and the release belt 64. A bottom section 68 of the press 36 has a plurality of platens 70 mounted on an endless chain 72. The endless chain 72 is mounted around a pair of spaced apart, toothed wheels 74, 76. The bottom section 68 is slightly longer in length than the combined length of the consolidation and cooling sections 38, 52. A support beam 78 is provided within the endless chain 72 and is mounted between the toothed wheels 74, 76. Each support beam 48, 62, 78 is supported on one side by a rigid frame (not shown) and on the other by adjustable hydraulic supports (not shown). The platens 70 on the bottom section 68 may be coated with a suitable no-stick material, such as a TEFLON® material or stainless steel.

The woven mat 26 and the film 34 start out on different conveying lines. Prior to entering the press 36, a supply of the film 34 is laid down on woven mat 26. A roller can be used to bend the film 26 as it is being laid onto the woven mat 26 to

ensure contact of the film 34 and the woven mat 26.

The woven mat 26 and the film 34 are conveyed together by suitable means, such as rollers (not shown), into and through the press 36 by passing between the consolidation section 38 and the bottom section 68, and then through the cooling section 52 and the bottom section 68. The platens 40 in the consolidation section 38 are heated when they pass along the top of their track by the heater 50 which may take a variety of forms, including, but not limited to, a burner box, hot gas vent, contact heating shoe, and the like. The heating of the woven mat 26 causes the thermoplastic resin 30 to melt and thin when pressure is applied by the press 36. The mat 26 reduces in thickness by more than 50% during processing. The platens 40 on the consolidation section 38 are kept from coming into contact with the heated film 34 and the heated thermoplastic resin 30 because the platens 40 contact the release belt 64, thereby preventing the heated film 34 and the heated thermoplastic resin 30 from adhering to the platens 40. Because the platens 70 on the bottom section 68 are coated with a suitable no-stick material, the heated thermoplastic resin 30 will not adhere thereto. The heated thermoplastic resin 30 and the film 34 are held under heat and pressure from the consolidation section 38 of the press 36 while the thermoplastic resin 30 impregnates the glass fibers 28 and consolidates to form the thin sheet of laminate 24. Simultaneously, the thin sheet of laminate 24 also bonds to the film 34 to form a layered structure. Therefore, formation of the sheet of laminate 24 and the bonding of the film 34 and the sheet of laminate 24 are effected together all in one integrated combined process.

Thereafter, the layered structure is cooled by contact with platens 54 in the cooling section 52 that are not heated. The consolidated glass fibers 28 and thermoplastic resin 30 is solidified and cooled in the cooling section 52. The layered structure passes through and between the cooling section 52 and the bottom section 68 by rollers. The platens 54 in the cooling section 52 are kept from touching the layered structure by the endless release belt 64. As the finished roof sheet 20 passes outwardly from between the cooling section 52 and the bottom section 68, the release

belt 64 is peeled away from the roof sheet 20 by means of the roller 66. The finished roof sheet 20 exits the continuous press 36 at a low enough temperature that the roof sheet 20 can be handled, cut and stacked without damage. When completed, the roof sheet 20 is secured to the frame of the trailer 22 by suitable means. A release belt, like release belt 64, can be used to enclose the bottom section 68, thereby eliminating the need to coat the platens 70.

The heating step can be shortened by preheating the woven mat 26 before the film 34 is placed thereon. Consolidation of the laminate 24 and bonding of the film 34 to the laminate 24 have a plurality of ranges of feasible temperatures, pressures and times. Temperature, time, and pressure during processing are interdependent variables. Higher platen temperatures allow lower heating times. Longer times allow lower consolidation pressure. Higher consolidation pressures increase heat transfer through the commingled fibers 28, 30 and allows for lower platen temperatures.

As shown in FIGURES 4 and 5, a pair of endless blocks 80 of silicone rubber-like material are mounted on the exterior of the platens 70 of the bottom endless chain 72 to prevent the melted thermoplastic resin 30 from overflowing the edge of the press 36 during consolidation. Thermoplastic tends to flow when heated, and the commingled fibers 28, 30 especially tend to flow during consolidation. The mass of unconsolidated commingled fibers 28, 30 has a larger volume than the final layered structure. As stated, the mat 26 reduces in thickness by more than 50% during processing. Unless contained, the melted thermoplastic resin 30 will flow out from the press 36, carrying the glass fibers 28 therewith. Furthermore, when the melted thermoplastic resin 30 flows, alignment of the glass fibers 28 is disturbed, thus reducing the effectiveness of the reinforcement of the resulting roof sheet 20 provided by the glass fibers 28.

The elongated blocks 80 are spaced apart from each other on the platens 70. The blocks 80 have a height which is greater than the height of the woven mat 26 in its initial state. The material of which the blocks 80 are formed must withstand repeated cycling at process temperatures.

When the mat 26 passes between the blocks 80, the mat 26 is spaced from the blocks 80 by a small gap 82. As the woven mat 26 and the film 34 move into the continuous press 36, the platens 40, 70 close on the blocks 80, locking the blocks 80 in place by friction to prevent the blocks 80 from being pushed sideways by the heated thermoplastic resin 30 as it flows within the press 36. The melted thermoplastic resin 30 flows up to the blocks 80 but is prevented from flowing out of the press 36 by the tight seal the blocks 80 make with the platens 40, 70. The overall height of the blocks 80 is large compared to its change in height during processing. This reduces the wear and tear on the blocks 80 thus increasing reusability.

The film 34, which may be formed from polyester, provides light diffusion, blocks ultraviolet light and adds color to the roof sheet 20. The usage of the film 34 results in approximately a 10% light transmission into the trailer 22.

While a preferred embodiment of the present invention is shown and described, it is envisioned that those skilled in the art may devise various modifications of the present invention without departing from the spirit and scope of the appended claims.

THE INVENTION CLAIMED IS:

1. A roof sheet for a trailer comprising: a thin sheet of laminate having a predetermined width and length formed from commingled fiberglass and plastic resin which has been heated and compressed.

2. A roof sheet as defined in claim 1, wherein said plastic resin is a thermoplastic.

3. A roof sheet as defined in claim 2, wherein said plastic resin is polypropylene.

4. A roof sheet as defined in claim 1, further including a film capable of blocking ultraviolet light bonded to said thin sheet of laminate.

5. A roof sheet as defined in claim 4, wherein said film is polyester.

6. A process of forming a roof sheet for a trailer comprising the steps of: providing a woven mat formed from rovings of commingled fiberglass and plastic resin; commingling said fiberglass and plastic resin to form a thin sheet of laminate by heating and compressing said woven mat; and cutting said thin sheet of laminate into a size which is suitable for attachment to a frame of a trailer.

7. A process as defined in claim 6, further including the step of bonding a film capable of blocking ultraviolet light to said thin sheet of laminate.

8. A process as defined in claim 7, wherein said film is polyester.

9. A process as defined in claim 6, wherein said plastic resin is a thermoplastic.

10. A process as defined in claim 9, wherein said plastic resin is polypropylene.

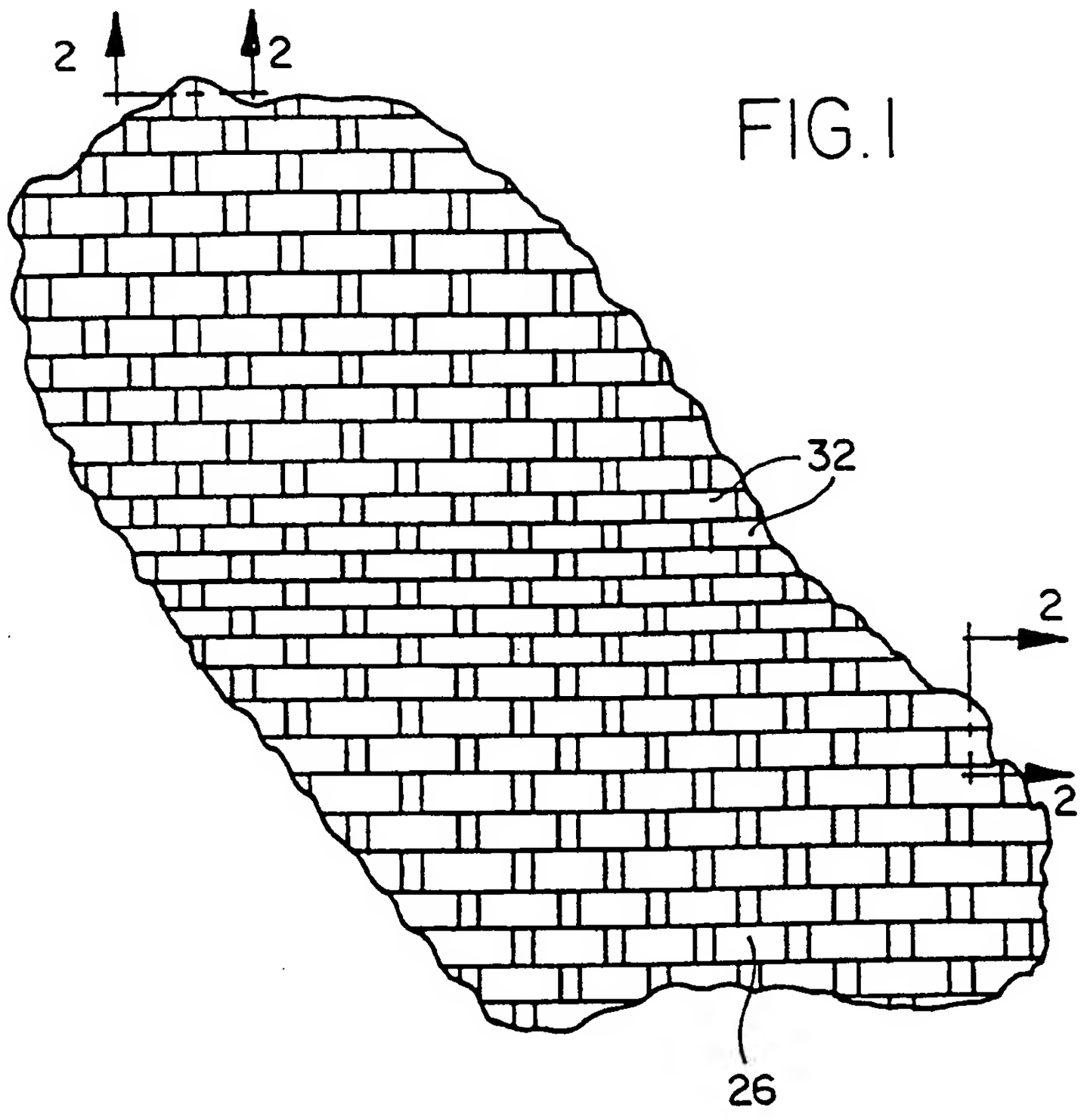
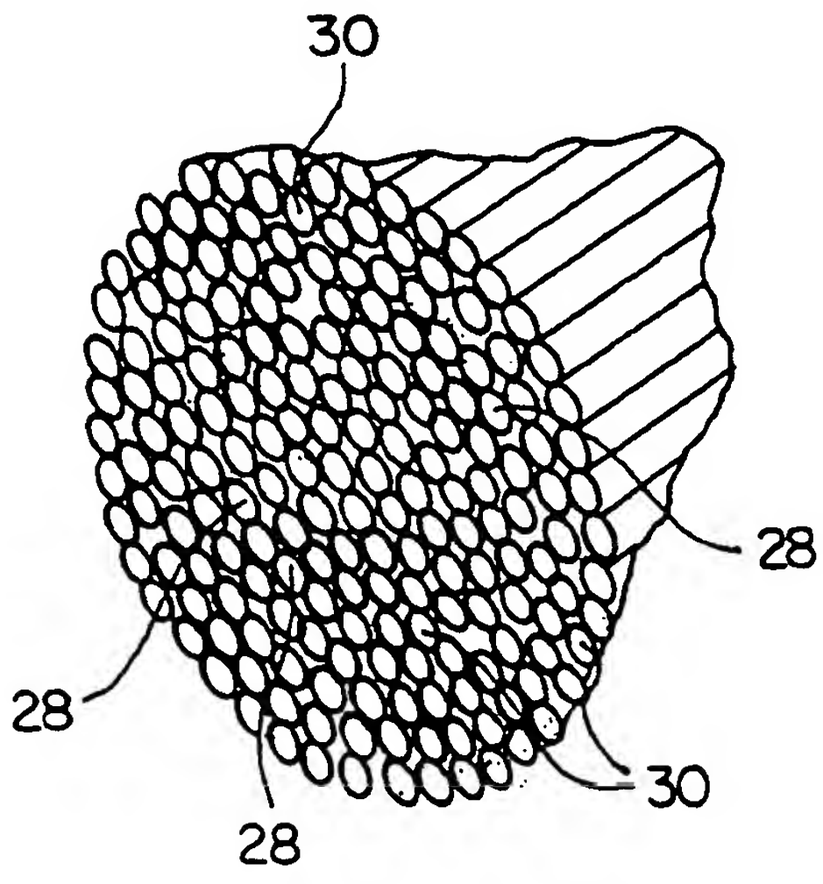


FIG.1

FIG.2



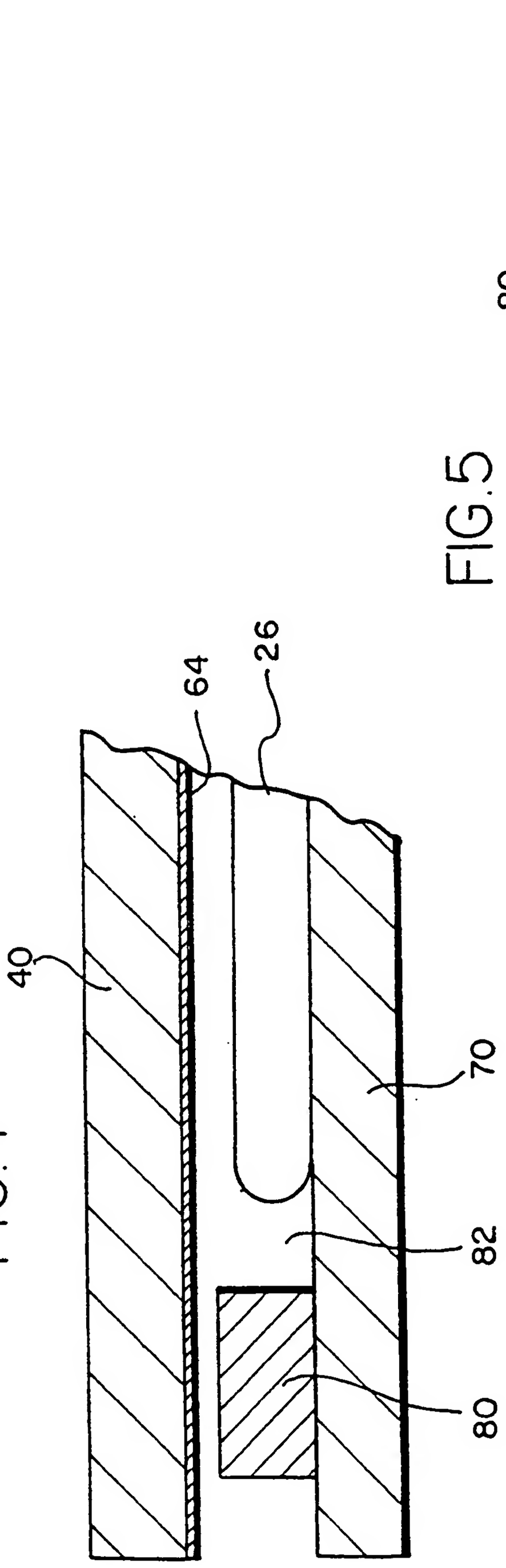


FIG.4

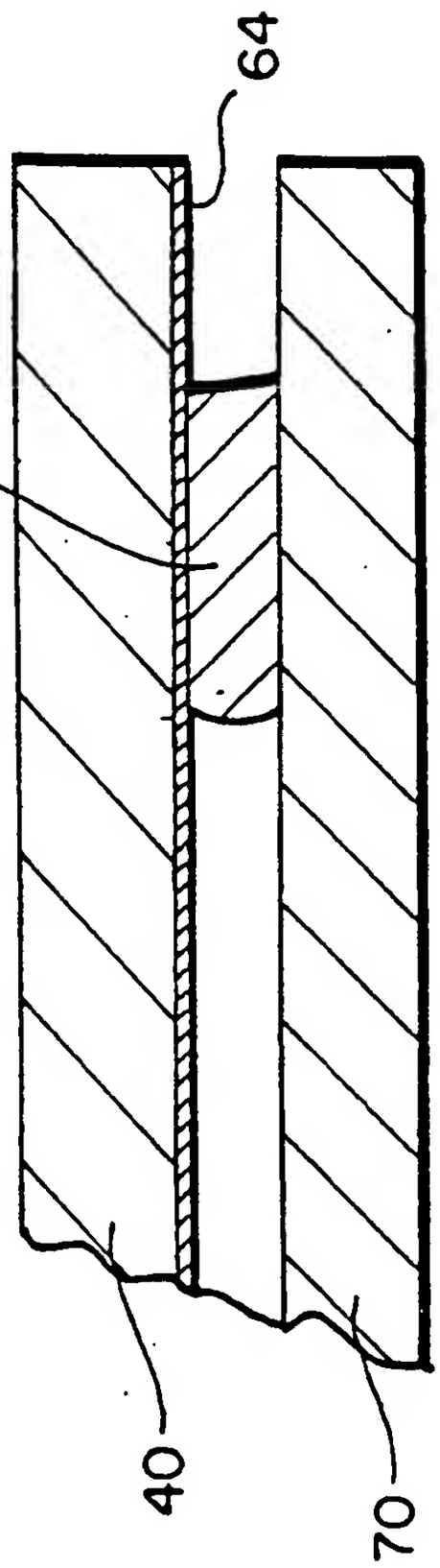


FIG.5

FIG.6

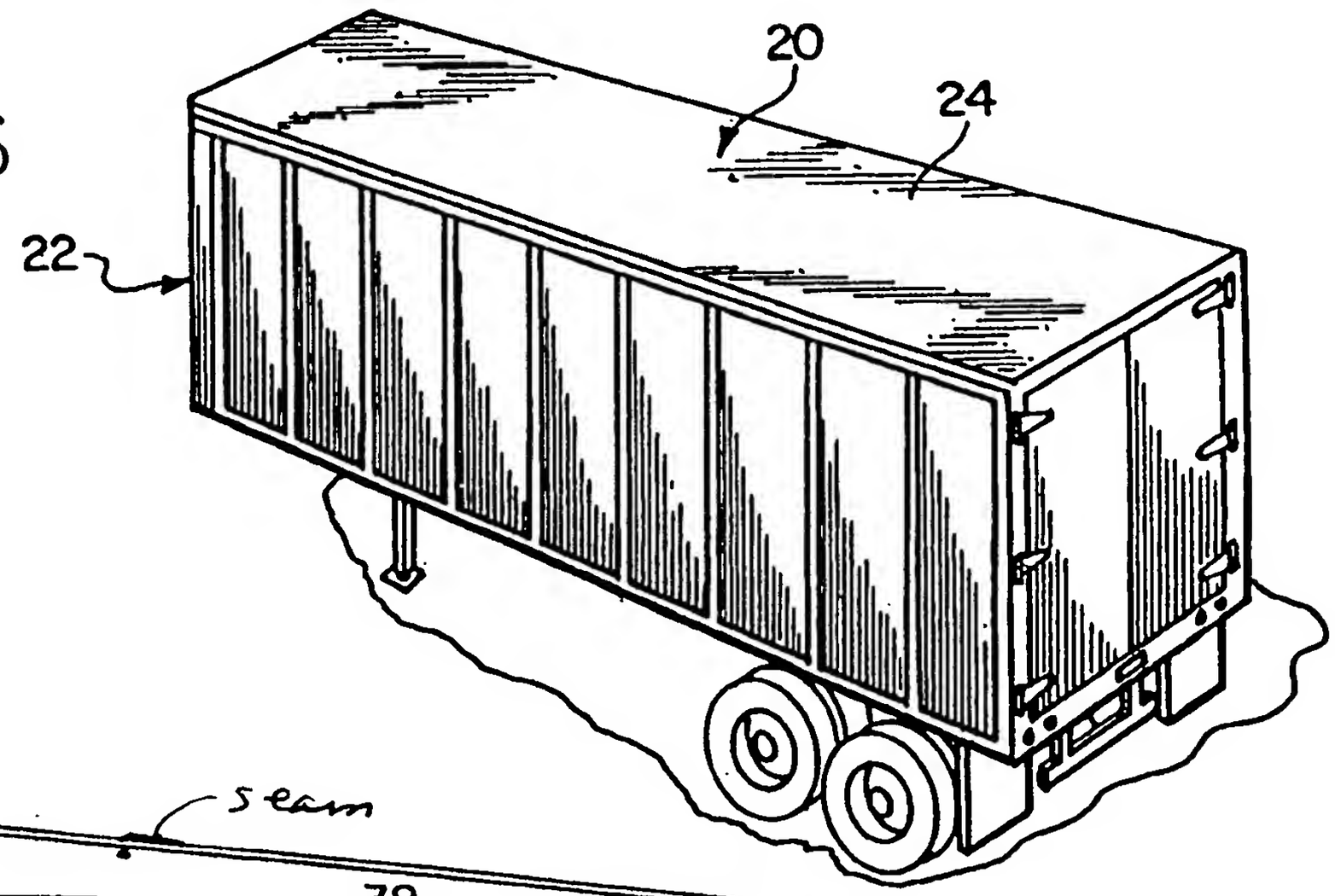

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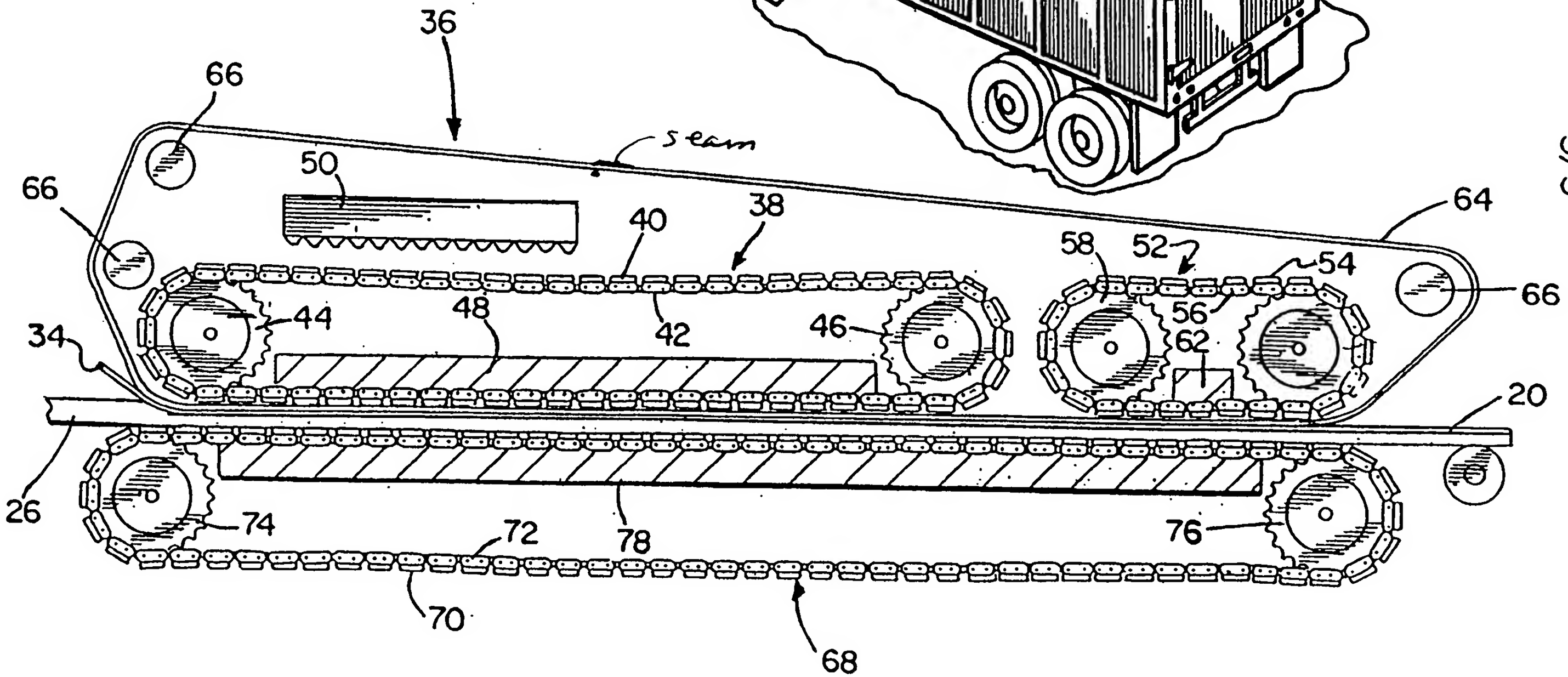
FIG.3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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/27989

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : B32B 5/02, 17/02, 17/04, 17/10, 27/04, 27/08, 27/12, 27/32, 27/36, 31/20, 31/26; C08J 5/04, 5/06, 5/18
US CL : 428/441, 480, 483; 442/172, 180, 286, 287, 394, 395; 264/112, 119, 299, 330, 331.15, 331.17

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 428/441, 480, 483; 442/172, 180, 286, 287, 394, 395; 264/112, 119, 299, 330, 331.15, 331.17

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,153,058 A (HALL et al) 06 October 1992 (06.10.1992), columns 1-2, 4; column 6, lines 66-68.	1-3 --- 4-5
X --- Y	US 4,948,661 A (SMITH et al) 14 August 1990 (14.08.1990), column 1, lines 55-68; column 2, lines 23-26; column 3, line 44 to column 4, line 21; column 5, lines 34-40.	1-3 --- 4-5
Y	US 4,469,543 A (SEGAL et al) 04 September 1984 (04.09.1984), column 2, lines 2-4, 48-53; column 3, lines 30-50; column 6, lines 42-53.	6-10
A	US 5,071,608 A (SMITH et al) 10 December 1991 (10.12.1991), columns 5-6.	1-10
A	US 4,454,287 A (LIU et al) 12 June 1984 (12.06.1984), column 1, line 55 to column 2, line 22; column 3, lines 22-42.	1-10
A	US 4,037,011 A (HATTORI et al) 19 July 1977 (19.07.1977), columns 6-7.	1-10

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
04 December 2000 (04.12.2000)	22 JAN 2001
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No.	Authorized officer Vivian Chen Telephone No. (703)-308-0661

Form PCT/ISA/210 (second sheet) (July 1998)